Description

PLANT WITH ROTATING FURNACE FOR THE MELTING WITHOUT SALT OF ALUMINIUM, WITH SCREENING AND RECOVERY OF THE SLAGS

Technical field

Object of the present invention is a modular plant for the melting of metallic materials, especially aluminium scraps, comprising a rotating furnace characterized by the lack of use of a salty bath, and with direct poured of the melted metal in a spherical store tank, an equipment for the selection and recovery of the slag of fusion and a system of scavenging.

State of the art

As it is known, the melting of the aluminium scraps, for the production of ingots for alloys, and also the remelting of the same aluminium ingots is realized in the rotating furnaces, also called salty bath furnaces, in which the sea salt (usually mixed with carbonate of soda, salnitro and yellow prussiato of potassium) is melted by the heat produced in the furnace.

Salt is a good receiver and transmitter of heat and its addition is useful as cover agent to prevent the oxidation of the metal in fusion. At almost 1000°C it reacts englobing the slag of fusion of the aluminium scraps. The principal drawback of these furnaces is the production of a notable quantity of refusals, essentially constituted by the salty products mixed to the slag of the process of fusion of the aluminium scrap. It originates therefore problems because of the disposal of these refusals and not always

the recycling of these refusals is possible and convenient from an economic point of view, because it engraves in notable way on the final price of the ingot of aluminium.

Scope of the invention

The principal scope of the present invention is to avoid the drawbacks of the preceding plants realizing mainly a rotating furnace for the fusion of primary and secondary aluminium that does not have to realize the fusion of the aluminium using a salty bath.

Other scope of the present invention is to realize a rotating furnace for the fusion of the primary and secondary aluminium, according with the preceding purposes, in which it is the direct and continuous pouring of the fused metal in a spherical store tank without any interruption of the process of fusion, so that to improve the use of fuel, of workforce, of salty materials, and the safety conditions of the job.

Other scope of the present invention is to get a plant of fusion of the aluminium according with the preceding purposes, that directly has an automatic and continuous system of selection and recovery of the slag of fusion integrated in the same plant, without necessity of following treatments in different places, so that to realize advantages in terms of costs related to the disposal of slag or its recycling.

Other scope of the present invention is to get a plant of fusion of the aluminium for the production of ingots for foundry, according with the preceding purposes, completely modular, such that the various units, putable on track, are separable to make easy both the construction and the assemblage of them, and the maintenance and the substitution because of usury.

Other scope of the present invention is to get a plant of fusion of the aluminium for the production of ingots for foundry, according with the preceding purposes, having a

system of scavenging that allows a smaller waste of thermal energy in the furnace of fusion and simultaneously a cleaning in the gases from the heavy pollutants before the stack and quality of the air breathed by the employees in the plant decidedly improved in comparison to the preceding plants.

Description of the drawings and way of realizing the invention

Further characteristics and advantages of the invention will result more clear from the following description and from the attached drawings, furnished to only indicative purpose and not limitative.

The fig. 1 shows, in a three-dimensional way, the general view of the system of fusion according to the present invention.

The fig.2 shows, in perspective section, the general view of the system of fusion according to the present invention.

The fig. 3 shows a longitudinal section of the general view of the system of fusion according to the present invention.

The fig. 4 shows, schematically and in a lateral point of view, a portion of the spiral element with the channels realized on it.

The fig. 5 shows, in a lateral longitudinal view, the equipment of treatment of the slag with the disposition for the scavenging and the tracks of moving.

The fig. 6 shows, schematically and in a general view, some component of the plant, mainly the store tank of the fused metal and the system of scavenging.

Accordingly to the drawings, the furnace that realizes the fusion of the primary and secondary aluminium (scraps), is constituted by a cylindrical hollow body (1), with circular section, built in refractory material, resistant to the thermal stress; on an

extremity the body (1) is closed by a porthole (2) used for the loading of the metallic scraps; on the other extremity it is the window of entry (3) of the flame of heat of the scrap and downward the hole (4) for the leakage of the fused liquid that, as illustrated by the drawings, is realized in a plain slot.

The inside diameter of the body (1) changes constantly along its longitudinal axle to originate a negative inclination on the horizontal line beginning from the extremity where is the loading porthole (2) up to the extremity where is positioned the hole (4) of leakage of the melted metal. The difference of inclination among the two extremities in comparison to the horizontal line is 2 centimetres for linear meter of the length of the furnace.

The furnace is covered by a metallic structure and is kept in horizontal position by metallic traverse frames (5) that place and creep on the slides (6) held on the metallic supports (7). On both the left and right extremities of the body (1) are the openings (8) and (9) for the scavenging of the fumes that join in a single channel of evacuation (10).

On the surface of the inside wall of the body (1) and along all its length, it is a spiral element (11), whose spires, in a first favourite and illustrated shape, are cylindrical, with circular section, with constant diameter and built in refractory material resistant to the heat and to the mechanical stress due to the action of the scrap in fusion. On the spires of the spiral element (11) and in the bottom side close to the wall of the cylinder body (1) are a multiplicity of galleries or channels (12) with a favourite semicircular section.

A channel of pouring (13), realized with a suitable inclination and adequately contained in an box (14) insulated and equipped with a window (15), is placed among the hole (4) and the spherical storage basin (16) positioned on a lower plan in a pit. The basin (16) has adequately been described and claimed in the patent WO 02/39044 by

the same applicant. The rotating joint (17), in comparison to that described in the aforesaid patent, has a different shape, so that to realize a continuity of inclination with the channel of pouring (13).

The principal characteristics of a preferred example of realization of the rotating furnace, for the fusion of the primary and secondary aluminium, are the followings:

external diameter: 500 centimetres

inside diameter: 320 centimetres

thickness of the refractory cement: 90 centimetres

length of the cylinder: 1200 centimetres

inclination for the pouring: 24 centimetres

working temperature: 750 - 800 °C

feeding: methane, oil

heat consumption: 750 Kcal/h for Kg/liquid aluminium produced

The furnace is maintained in a slow rotation, from one to four revolution/minute, on its mean axle by a gear motor.

Description of the process of fusion

If the melting of secondary aluminium is preferred, at first is realized the selection and mixing of different types of aluminium scraps, whose chemical composition has to be as close as possible to that of the desired alloy. Then the aluminium scraps are set, through the loading porthole (2), in the rotating furnace without addition of sodium chloride as cover agent to prevent the oxidation of the metal.

Because of the rotation of the furnace and the special inside conformation, is obtained the mechanical remixing of the scrap in fusion with, simultaneously, an action of

carried of the material by the walls of the furnace. The metal gradually melts and the liquid aluminium begin to rotate in the same sense of rotation of the furnace; it will always be positioned in the low part of the furnace, because the force of gravity is higger then the carry force due to the rotation. Moreover, because of the rotational movement, joined to the inside inclination of the furnace, the liquid metal continually slide to the drawing hole (4) that is put in the lowest point, flowing through the small channels (12) transversally set to the spires of the body (11).

The liquid metal is protected against the oxidation of the air because of its low position, it is not directly licked up by the stream of the warm gases (whose flow is horizontal and situated in the tall part of the furnace), and because it continually flow in the basin (16) where the fused metal is stored, through the pouring channel (13). The slags remains in the tall part and are held by the spiral body (11) and, once all the aluminium is melted and has been stored in spherical basin, are discharged close to the loading porthole through a channel equipped with a cochlea, finishing the process of melting.

The slags, put in the channel and pushed by the cochlea, reaches the module of selection wherein they enter from the extremity (18). The module of selection is constituted by three hollow metallic and coaxial cylinders, one inserted in the other, and open to the left end, and is kept in horizontal position by booms (19) and metallic traverse frames (20) that place and creep on the slides (21) joined on metallic supports (22) with the interposition of a gear carriage (23).

The cylinders (24) and (25) have the surface side equipped with holes, greater on the first cylinder (24) and smaller on the second (25) so that it is possible the pouring of slags of different dimensions. The whole, constituted by the three cylinders, has put in slow rotation around the longitudinal axle, so have a remixing of the slags as soon as

they advance along the cylinders pushed by the cochlea. The slag, according with their weight and dimensions, passes from the first cylinder (24) up to the last one (26). Actually, in the first cylinder (24), with smaller diameter, are the slags essentially constituted by iron parts, steel, copper, that is material that has few or not put through the process of fusion; in the second cylinder (25) are the slags of aluminium oxide, while in the third cylinder (26) are essentially the dusts. It is very interesting the fact that the slags, flowing, are selected as well as they are cooled. The slags, so treated, flow out of the extremities of the cylinders and fall in the channels (27), (28), (29) positioned everyone below a cylinder and, by a cochlea system present in every channel, are pushed, at almost ambient temperature, in the storage buckets.

The recovered aluminium oxide is recycled and joined to the feeding charge of fusion.

All the exhaust gases produced in the module of selection and recovery of the slag are carried, through canalizations, to the cap (30), and don't escape in the external environment.

It is very important that the module of selection and recovery of the slag is constituted by units, placeables on tracks, (31), so that they can be open for inspections and maintenance.

Even if it is not represented in the drawings, the furnace of fusion is also modular, put on carriages that are moved on tracks, to make possible the opening.

Other great innovation is the system of scavenging, constituted by two separate canalizations. The warm gases, originated by the furnace of fusion at a maximum temperature of 300°C, are carried through the pipeline (32) in the underground pit (33) accessible by a porthole of inspection (34). The gases exclusively escape from the furnace of fusion, because of the concomitant action due to the kinetic energy (that originates from their heat), to the expansion that they have by reaching the pit (33), to

the loss of pressure produced by the chimney (35) and to the drag force produced by the air flow, at a great speed, that escapes from the extremity (36) of the pipeline (37). In the pit (33) the warm gases, because of the expansion, decrease in temperature and also realize a first falling of the heaviest particles of pollutant agents in the gases.

All the other gases that escape from the modules, having a lower temperature, are carried to the pipeline (37) by extractors, continuing in an underground pipeline (38) up to the chimney (35) equipped with various devices of cleaning of the dangerous gases for the environment according to the laws in force.

Both pipelines (32) and (37) are equipped with a control valve (39) for the automatic passage of the gases. The present system, besides the aforesaid advantages, realizes also an energetic conservation in the furnace of fusion, because the gases are evacuated in natural way and only in the quantity necessary to the process of combustion, not having additional quantities of heat for an excess of evacuation of the gases.

As previously described and illustrated, it is clear that the invention reaches the scope. Dimensions and shapes can be adjusted according to the demands.